

## ABSTRACT OF THE DISCLOSURE

A wavemeter and method for measuring bandwidth for a high repetition rate gas discharge laser having an output laser beam comprising a pulsed output of greater than or equal to 15 mJ per pulse, sub-nanometer bandwidth tuning range pulses having a femptometer bandwidth precision and tens of femptometers bandwidth accuracy range, for measuring bandwidth on a pulse to pulse basis at pulse repetition rates of 4000Hz and above, is disclosed which may comprise a focusing lens having a focal length; an optical interferometer creating an interference fringe pattern; an optical detection means positioned at the focal length from the focusing lens; and a bandwidth calculator calculating bandwidth from the position of interference fringes in the interference fringe pattern incident on the optical detection means, defining a  $D_{ID}$  and a  $D_{OD}$ , the respective distances between a pair of first fringe borders and between a pair of second fringe borders in the interference pattern on an axis of the interference pattern, and according to the formula  $\Delta\lambda = \lambda_0 [D_{OD}^2 - D_{ID}^2] / [8f^2 - D_0^2]$ , where  $\lambda_0$  is an assumed constant wavelength and  $D_0 = (D_{OD} - D_{ID})/2$ , and  $f$  is the focal length. The optical detector may be a photodiode array. The wavemeter may have an optical interferometer having a slit function; the slit function and the focal length being selected to deliver to the optical detector the two innermost fringes of the optical interference ring pattern. The optical detector may comprise an array of pixels each having a height and width and the array having a total width; and an aperture at the optical input to the optical interferometer may selectively input to the optical interferometer a portion of a beam of light sufficient for the output of the etalon to illuminate the optical detector over the height of each respective pixel height and the total width. The optical interferometer may comprise an etalon having a slit function of 3pm or less and a finesse of 25 or greater; and the focal length may be 1.5 meters. A second stage diffuser may be placed between the first stage diffuser and the etalon delivering a narrow cone of light to the etalon, and an aperture between the second stage diffuser and the etalon may deliver to the etalon a thin strip of the narrow cone of light.